

VICTORIAN SPECIES OF *GLEICHENIA* SMITH
(SUB-GENUS *MERTENSIA*)

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Abstract

An account is given of the 3 Victorian species of *Gleichenia* (sub-genus *Mertensia*). For one of these species, *Sticherus lobatus* Wakefield, a new combination is necessary; it is here transferred to *Gleichenia* as *G. lobata* (Wakefield) Thrower comb. nov.

A description of the general morphology and spore morphology of each species is given. Chromosome counts for *Gleichenia flabellata* ($n=34$), *Gleichenia tenera* ($n=68$) and *Gleichenia lobata* ($n=34$) have been made.

Introduction

The family Gleicheniaceae is represented in Victoria by 5 species. Two of these show the very small pinnules and bipinnatifid division of the ultimate branches which puts them into the sub-genus *Gleichenia* of *Gleichenia*. The other 3 species show the characters (larger pinnules and pinnate division of the ultimate branches) of the sub-genus *Mertensia*. The definitions adopted herein of the genus *Gleichenia* and its sub-genera are those given by Holttum (1957a, 1957b, 1959) in his monograph of the family Gleicheniaceae. Some other recent authors have used the generic name *Sticherus* Presl. for the species included in *Gleichenia* sub-genus *Mertensia* by Holttum.

Of the 3 species dealt with in this paper, *Gleichenia flabellata* R.Br. has been described a number of times since Robert Brown's first description in 1810. It has been excellently figured in Hooker's *Filices Exoticae* (1859) and there is little difficulty in recognizing the fern as one sees it in the field or herbarium. This fern, however, is of rare occurrence in Victoria (2 records only) and the common Victorian species *Gleichenia tenera* R.Br. has frequently been mistakenly recorded and described as *G. flabellata* R.Br. (eg. Ewart 1930). A third species, *Sticherus lobatus* Wakefield, was described in 1943 by Wakefield. This species was earlier confused with yet another (*Gleichenia laevigata* (Wild.) Hk.) which does not occur in Victoria.

The 3 species appear in J. H. Willis's *A Handbook to Plants in Victoria* p. 12-13 (1962) under the generic name of *Sticherus*.

The opportunity has been taken to give full descriptions of these 3 species as they are found in Victoria, as well as details and illustrations of spores and chromosomes.

Methods and Materials

The material on which these descriptions are based is from the following sources: dried specimens from the National Herbarium, Melbourne; from the herbarium of the University of Melbourne Botany Department; from private herbaria; and living material grown in the greenhouse at the University Botany Department. Wherever measurements have been given in the descriptions, the first figure refers to the calculated mean values and the following figures in brackets refer to the actual range of measurements. It should be stressed that in each case approximately

30 specimens provided material for these measurements and, with a greater sample of the species population, the range without doubt would be markedly increased. The figures are given, however, because it is felt that some indication of mean size and range of variation is useful despite the fact that it may not cover the full amplitude of individual variation within the species. This proviso also applies to the figures given in Table 1, which summarizes the distinguishing macroscopic features of the 3 species. These features apply to well developed fronds; fronds from young plants are smaller, less branched and do not show, for example, lobing of the pinnules.

The characters of *Gleichenia tenera* especially show marked variation. It is thus necessary to consider the sum of its characters when attempting to identify a specimen, rather than concentrating on a single, often inconclusive feature. Whilst *Gleichenia flabellata* and *Gleichenia lobata* are generally readily recognized, the same cannot be said of *G. tenera*; indeed it is almost diagnostic of this species that it should be difficult to be certain of its identification.

Mature plants used for chromosome counts were grown in the greenhouse from young plants collected in the field. For each count sporangia from one plant were used.

Chromosome counts were made on material preserved in acetic acid-alcohol and stained with aceto-carmin using a squash technique devised by Dr M. B. Blackwood (personal communication) of this Department. This technique is a modification of that given by Manton (1950).

Mature spores were collected from a number of plants in the field. These were treated as described by Erdtman (1952).

TABLE 1

Summary of differences which are useful in distinguishing between the 3 Victorian species of *Gleichenia*, sub-genus *Mertensia*

	<i>flabellata</i>	<i>tenera</i>	<i>lobata</i>
pinnule margin	serrate	slightly crenate	entire
approx. angle between pinnae and rachis on final branches	45-65°	55-70°	80-90°
position of longest pinnules	on final branches of rachis	on final branches of rachis	on first and/or second branches of rachis
presence of pinnules on first fork of rachis	rare; if present, short	usual, often on one side only of each rachis branch	usual, generally on both sides of each rachis branch
lobed or pinnatifid pinnules	rarely if ever present	often on first fork of rachis	often on first fork of rachis
approx. ratio of lengths of first, second and third forks of rachis	1:2:22	1:2:7	1:2:8
approx. angle between rachis forks	30°	50°	60°

Key to the 3 Victorian species of *Gleichenia* sub-genus *Mertensia*

- (1) Total length of the first two forks usually to 3 cm (rarely to 5 cm), making up $\frac{1}{2}$ to $\frac{1}{10}$ of the total frond length; the first forking rarely with pinnules *G. flabellata*
- (1) Total length of first two forks usually 3-10 cm, rarely less, making up $\frac{1}{2}$ to $\frac{1}{2}$ of the total frond length; the first forking usually with pinnules 2
- (2) Angle between pinnule and rachis usually 80-90°, longest pinnules often on first or second forkings *G. lobata*
- (2) Angle between pinnule and rachis usually less than 80°, longest pinnules usually on third (or final) forkings *G. tenera*

Detailed Descriptions

These 3 species of *Gleichenia* share a number of features, some of which are generic features and some are common specific features.

As, on the one hand, this study does not encompass all members of the genus and, on the other hand, complete description of each species in turn would involve much repetition, the ensuing descriptions are arranged in the following manner:

1. Description of the common features of the 3 species.
2. Short descriptions of each species including only those features which are particular to that species.

DESCRIPTION OF FEATURES COMMON TO THE 3 SPECIES

RHIZOME: Dark brown, long branched, creeping on or near the surface of the ground, the tip growing out beyond the youngest frond. Dorsiventral, the under surface with roots, the upper surface with fronds. Frond bases alternate, separate and persistent. Rhizome scaly, particularly at growing tip and frond bases, scales deciduous on older parts. Scales of moderate size, dark brown, narrow, triangular, with fringed margins and prolonged apices; not clathrate. Attachment simple, tending to peltate in large scales.

FROND: Fanshaped in outline, spreading to upright in form, stipe erect, dark brown at base, grooved on the upper surface of dried specimens (the groove single), glabrous or sparsely scaly except for a basal tuft of scales like those on the rhizome. Lamina colour mid-green, the upper surface darker; texture firm; sterile and fertile fronds similar.

Frond dissected, the divisions being pseudo-dichotomous (the rachis bifurcate with a bud at the angle).

Forking repeated twice or thrice giving finally usually 8 spreading pinnate branches of second and later forkings with simple pinnules.

Bud dormant or unrolling to give two or more tiers of laminae (up to 6 tiers in *G. tenera*). Each tier is an annual increment according to Bond and Barrett (1934).

Rachis yellow-green, branches of the first fork often grooved on the upper surface (the groove single); scaly, especially at the angles and clothing the dormant bud.

Upper surface of frond glabrous, except for long simple hairs occurring in the grooves between the raised upper surface of the rachis and the pinnules attached on each side of it; under surface with sparse hairs and scales. Hairs simple or grading into small fringed scales of the type found on the rhizome and dormant buds, but simpler.

ULTIMATE SEGMENT OR PINNULE: Linear in outline, attachment to rachis usually alternate, occasionally opposite. Sessile, attached by whole, slightly broadened base. Apex acute. Venation open.

SORI: Sporangia aggregated into definite sori on the underside of the pinnules, usually nearer the rachis and absent from the pinnule tip. Also usually absent from the small upper pinnules. Sori in 2 rows along the pinnule, each sorus situated midway along the acroscopic arm of a forked vein. Each sorus of 3-5 sporangia grouped in a uniseriate ring around a small central receptacle. No indusium, receptacle usually with long, simple hairs.

SPORANGIA: Yellow-brownish, stalk extremely short, sporangia almost sessile, annulus a complete ring of indurated cells with no specialized stomium, opening by a longitudinal split across the top. Proximal and distal faces unequally developed (distal face the smaller).

SPORES: Monolete, without perispore.

DESCRIPTION OF FEATURES PARTICULAR TO EACH SPECIES

Gleichenia flabellata R.Br.

syn. *Sticherus flabellatus* (R.Br.) St John

TYPE: Robert Brown, Port Jackson, N.S.W. (BM, dupl. at K and MEL).

RHIZOME: Mean diameter .35 cm (.30-.45). Distance along the rhizome between frond bases 0.5-2.0 cm.

FROND: Mean length (excluding stipe) 20 cm (10-30), mean width 30 cm (14-45). Stipe to 50 or more cm long with mean diameter 0.3 cm (0.1-0.4). Very dark brown at base, buff to yellow-green higher up, sparsely scaly. Upper surface of frond shiny, undersurface of frond variable—light green in Victorian specimens, distinctly glaucous in some Queensland and N.S.W. specimens. Texture thin but firm. Ratio of mean length of first, second and third forked branches 1:2:22, sum of the lengths of the first two forks comprising 13% (7-22) of the total length of the frond. Angle between the two branches at a forking (either first, second or third) 34° (20-45). First forking of the rachis rarely with pinnules, very short ones occasionally found.

ULTIMATE SEGMENT OR PINNULE: Pinnules attached close together along the rachis on the upper parts of the frond with no space on the rachis between successive pinnule bases, on the lower parts more widely separated (3-5 mm apart). Seldom occurring on the first pair of branches of the rachis. Angle between the pinnule axis and the rachis 45-65°. The ratio of length to breadth in the longer pinnules up to 15 or 17:1, pinnules shorter near bifurcations of the rachis and toward the pinna tip, longest pinnules almost always midway along the branches of the third forking of the rachis. Margin entire near the rachis, becoming serrate about half way along its length.

SPORES: Size $25 \times 48\mu$ (23-28 \times 40-51) surface smooth.

CHROMOSOME NUMBER: $n = 34$.

DISTRIBUTION: Vic.: extreme E. only—Genoa, Howe Ranges; N.S.W.; Q.; New Caledonia; New Zealand; New Guinea.

Gleichenia tenera R.Br.

syn. *Sticherus tenerus* (R.Br.) Ching

TYPE: Robert Brown, Table Mountain, Derwent, Tasmania (BM).

RHIZOME: Mean diameter .37 cm (.30-.40). Distance along the rhizome between frond bases 2.5-5.0 cm.



FIG. 1—*Gleichenia flabellata* R.Br. (a) frond; (b) underside of fertile pinnule showing sori; (c) tip of pinnule showing serrate margin; (d, e, f, g) hairs and scales from the undersurface of pinna and pinnule axis, $\times 40$; (h) diagrammatic section of the rachis of an ultimate branch, $\times 100$; (i) hair from the upper surface of rachis in the groove between rachis and pinnule, $\times 40$.



FIG. 2—*Gleichenia tenera* R.Br. (a) young frond; (b) first fork of the main rachis showing lobing of the lower pinnules [in this specimen these pinnules were not paired—pinnules were developed on the near side of the rachis until after the 2nd forking had occurred]; (c) tip of pinnule showing margin which is entire to slightly undulate; (d) underside of fertile pinnule showing sori; (e) diagrammatic section of the rachis of an ultimate branch, $\times 25$; (f-k) hairs and scales. [(f) hair from upper surface of rachis, in the groove running between the rachis and pinnules. These long simple hairs appear to occur only in this position. (g, h, i) hairs from undersurface of pinnule costules. (j, k) scales from undersurface of rachis. Scale f-k $\times 40$.]

FROND: Mean length (excluding stipe) 21 cm (9-37), mean width 27 cm (16-44). Stipe glabrous, to 75 + cm long, mean diameter .27 cm (.10-.40). Dark brown at the base shading through buff to yellow-green in its upper parts. More or less circular in section in fresh material. Ratio of mean lengths of first, second, and third forked branches 1:2:8, sum of the lengths of the first two forks comprising 27% (19-44) of the total length of the frond. Angle between the two branches at a forking (either first, second or third) 51° (35-70). All forkings of the rachis with pinnules, on the first division often atypical in being unpaired, on the inner side of the rachis only; and lobed.

ULTIMATE SEGMENT OR PINNULE: Attached close together along the rachis on the upper part of the frond with no space on the rachis between successive pinnule bases, on the lower parts more widely separated, (1-2 mm apart). Angle between the pinnule axis and the rachis 55-70°. Ratio of length to breadth in larger pinnules up to 8 or 10:1, pinnules shorter near the rachis bifurcations and toward the pinna tip, longest pinnules midway along the ultimate division of the rachis. Pinnule margin almost entire (the apical portion may be slightly serrate or crenate).

SPORES: Size $23 \times 43\mu$ (20-30 \times 40-51). Surface stippled, with many small irregularities; having the appearance of being finely pitted.

CHROMOSOME NUMBER: $n = 68$.

DISTRIBUTION: Vic.: Wilson's Promontory, South Gippsland Highlands, Grampians, Mt Buffalo, Dandenong Ranges, Mt Blackwood, Glenelg River, Bogong High Plains; Tas.; N.S.W.

Gleichenia lobata (N. A. Wakefield) Throter comb. nov.

syn. *Sticherus lobatus* N. A. Wakefield

TYPE: N. A. Wakefield, Mt Drummer, E. Vic. s.n. 6/7/41 (MEL).

RHIZOME: Mean diameter .32 cm (.20-.45). Distance along the rhizome between frond bases 0.5-4.0 cm.

FROND: Mean length (excluding stipe) 21 cm (12-30), width 29 cm (17-65). Stipe glabrous, dark brown often throughout its length, sometimes lighter at the top. Mean diameter 0.25 cm (0.15-0.50) more or less circular in section in fresh material. Texture firm or slightly harsh. Ratio of mean lengths of first, second and third forked branches 1:2:7, sum of the lengths of the first two forks comprising 30% (18-45) of the total length of the frond. Angle between the two branches at a forking (either first, second or third) 60° (30-100). All divisions of the rachis with pinnules, those on the first division on both sides of the rachis and often large, lobed or pinnatifid.

ULTIMATE SEGMENT OR PINNULE: Successive pinnule bases joined for about 1 mm depth to give deeply pinnatifid rather than pinnate division of the pinnae, except on first bifurcation of the rachis where first few pairs of pinnules often separated by 1 to several mm. Angle between the pinnule axis and the rachis 80-90°. Ratio of length to breadth in the longer pinnules up to 8 or 10:1, the longest pinnules frequently on branches of the first or second forkings of the rachis, pinnules shorter at rachis bifurcations and toward the pinna apex. Lengths of the inner and outer pinnules at the angles of the second and third rachis forks markedly unequal. Margins entire (sometimes slightly sinuate).

SORI: Sorus usually 4-7 sporangia. If more than 4 the receptacle often with a basal uniseriate ring of sporangia surmounted by a single sporangium at the top.

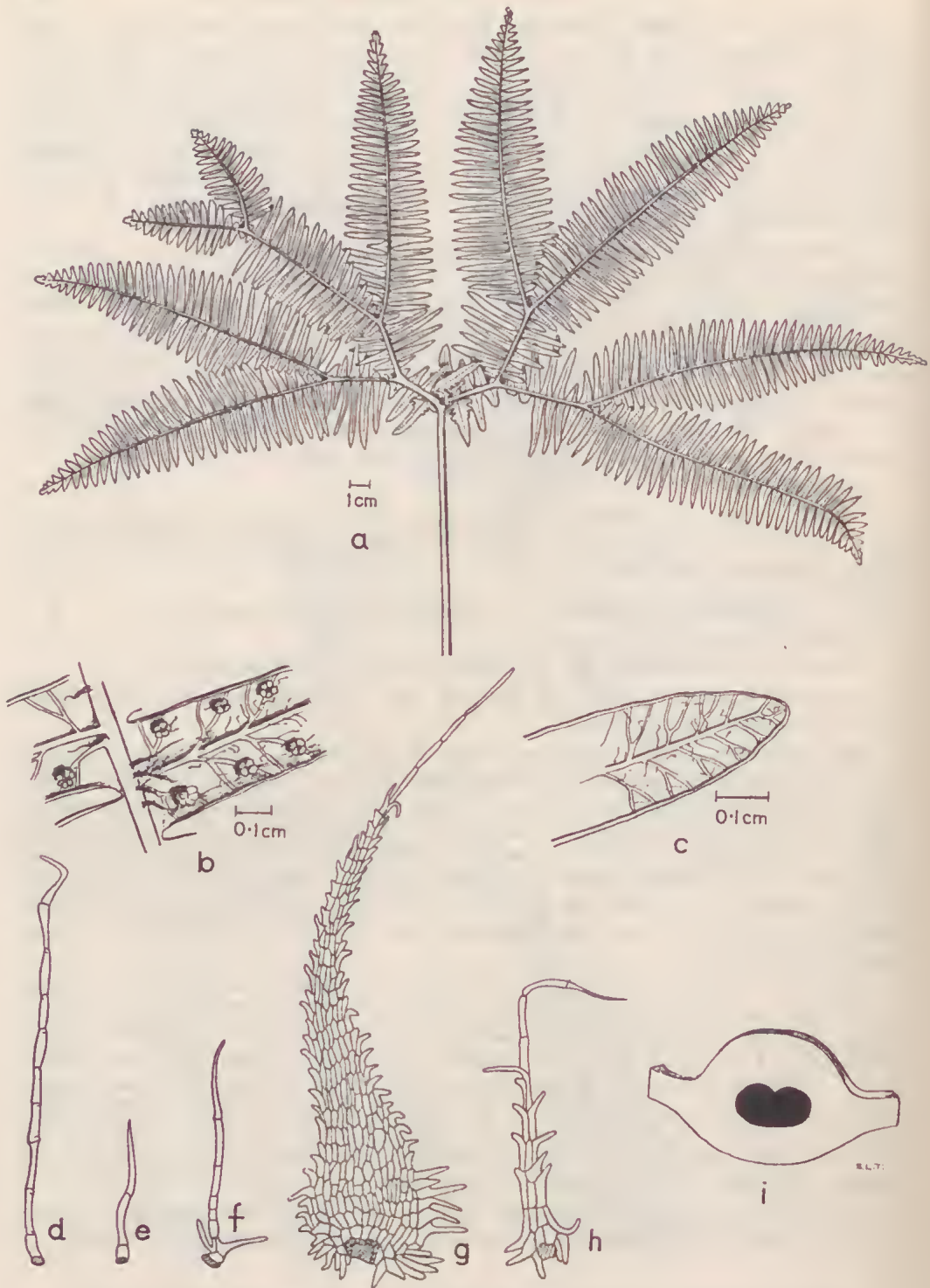


FIG. 3—*Gleichenia lobata* (Wakefield) comb. nov. (a) frond; (b) underside fertile pinnule showing sori; (c) underside pinnule tip showing entire to slightly sinuate margin; (d) hair from upper surface of junction between axis and pinnule blade; (e and f) hairs such as are found on the underside of the lamina of the pinnules and on the pinnule axis, $\times 40$; (f and h) hair and scale of type found on underside of pinna axis (h is a small specimen), $\times 40$; (g) scale from axillary bud investment, $\times 40$; (i) diagrammatic section of the rachis of an ultimate branch, $\times 40$.

SPORES: Size $20 \times 38\mu$ (18-30)-(35-49), surface stippled with many small irregularities, having the appearance of being finely pitted.

CHROMOSOME NUMBER: $n = 34$.

DISTRIBUTION: Vic.: Mt Drummer, East Gippsland Ranges, Dandenong Ranges; Tas.; N.S.W.; Q.

Discussion

It has been shown that the species *Gleichenia tenera*, which was thought by Hooker (1860), Bentham (1873), and Bailey (1881) to be only a smaller variant of *Gleichenia flabellata*, has a chromosome number $n = 68$, *G. flabellata* having the number $n = 34$. Recently Brownlie (1961) has published the chromosome number of New Zealand material of *G. flabellata* which agrees with the Victorian material in having the number $n = 34$. *Gleichenia lobata* has a chromosome number $n = 34$.

There are a number of possibilities which may be considered in attempting to determine the origin of the tetraploid *G. tenera*. There may have been simple doubling of the chromosome complement of *G. flabellata*, *G. lobata*, or an unknown species of *Gleichenia* not now found in Victoria, in which case *G. tenera* would be an autopolyploid. Again, a hybrid may have formed between *G. flabellata* and *G. lobata*, or between one of these and an unknown species, and the chromosome number subsequently doubled giving rise to an allopolyploid. The available evidence suggests that this latter hypothesis is the more likely. If autopolyploidy has occurred, it is customary to find quadrivalents, trivalents and univalents as well as bivalents at metaphase. Pl. XIX shows that all the chromosome configurations of *G. tenera* are bivalents. This is an indication that the species is an amphidiploid of hybrid origin. Furthermore, the morphological variability exhibited by *G. tenera* is suggestive of hybrid origin.

It has been observed with hybrid ferns that these often show a high percentage of shrivelled spores in the sporangium. This has not been observed for *G. tenera*, but would not be expected if the species is an amphidiploid.

From Pl. XIX it can be seen that the chromosomes of *G. lobata* and *G. flabellata* show a noticeable difference in size and in depth of staining. The chromosomes of *G. tenera*, while all showing good staining properties, show beside, a range of sizes which can be matched by chromosome sizes of *G. flabellata* and *G. lobata*. While without more intensive matching of the chromosomes in the diploid and tetraploid cells it is impossible to make a firm decision, it is possible to say, however, on the existing evidence, that *G. tenera* is probably of amphidiploid nature with a possibility of the parents being *G. lobata* and *G. flabellata*.

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Explanation of Plate

PLATE XIX

- FIG. 1—*Gleichenia flabellata* chromosomes ($n = 34$) $\times c.$ 1300.
- FIG. 2—*G. flabellata* spore, equatorial view. $\times c.$ 1300.
- FIG. 3—*Gleichenia tenera* chromosomes ($n = 68$) $\times c.$ 1300.
- FIG. 4—*G. tenera* spore, equatorial view, $\times c.$ 1300.
- FIG. 5—*Gleichenia lobata* chromosomes ($n = 34$) $\times c.$ 1300.
- FIG. 6—*G. lobata* spore, equatorial view, $\times c.$ 1300.